A COMPARISON OF INTERFERENCE AND REACTIVE INHIBITION IN EXTRAVERSION-INTROVERSION

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TO VICKI AND ADAM

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CHAPTER I

INTRODUCTION

The present study took issue with the theoretical basis of the Maudsley Personality Inventory (MPI), which is based on the effect of reactive inhibition on learning, and attempted to test an alternate theory.

The MPI (Eysenck, 1962) was constructed to measure two supposedly independent and constitutionally based dimensions of personality: Neuroticism-Stability (N) and Extraversion-Introversion (E). Eysenck arrived at these two dimensions by factor-analytic studies of questionnaires and ratings (Eysenck, 1965^{a}). The reliability of the test has been well established, with split-half, Kuder-Richardson, and test-retest reliabilities falling between .75 and .85 over many samples.

Numerous factorial validity studies have supported the existence of two independent factors. For example, Hildebrand (cited in Eysenck, 1962) administered a large battery of cognitive and personality tests to hospitalized neurotic patients and normals and factor analysis yielded three factors identified as introversion-extraversion, neuroticism, and general intelligence. The MPI scales have also been shown to correlate highly with other scales purporting to measure the dimensions of extraversion-introversion and neuroticism-stability. In the original scale used for item analysis the MPI extraversion scale correlated .79 with the Guilford-Rhathymia scale and the MPI neuroticism scale correlated

.92 with the Cycloid Disposition scale (Eysenck, 1962). Eysenck also quotes data demonstrating the validity of the MPI in discriminating between groups nominated as high or low as diagnosed by experienced judges on dimensions of extraversion-introversion and neuroticism-stability.

Neuroticism.-- Neuroticism is related to an excessive lability of the autonomic nervous system (ANS). The ANS's of some individuals are predisposed to respond more strongly, more lastingly, and more quickly. Clinically, neuroticism seems more closely identified with anxiety. Eysenck cites the work of Lacey, Malmo, Wenger, and others in support of differential lability of the ANS (1965a, pg. 32).

Extraversion-Introversion.-- Extraversion-introversion refers to the excitation-inhibition ratio of the central nervous system and is rooted in the theoretical work of Pavlov and Hull. According to Eysenck (1965a) excitation refers to the arousal of the cortex and general facilitation of the learning process, while inhibition refers to the inhibition of the cortex, which interferes with the learning process. A cornerstone of the theory is the concept of reactive inhibition, which is supposedly generated whenever a response occurs and acts as a barrier to repetition (Hilgard, 1956).

> "Individuals in whom reactive inhibition (RI) is generated quickly, in whom strong RI's are generated, and in whom RI is dissipated slowly are thereby predisposed to develop extraverted patterns of behavior and to develop hysterico-psychopathic disorders in case of nervous breakdown; conversely, in individuals in whom RI has developed slowly, in which weak RI's are generated, and in whom RI is dissipated quickly are thereby predisposed to develop introverted patterns of behavior and to develop dysthymic disorders in case of nervous breakdown" (Eysenck, 1955).

In other words, introverts are postulated to learn more easily, and, therefore, to acquire the conditioned anxieties and fears characteristic of the dysthymic more easily than other people, whereas psychopaths and hysterics (extraverts) generally are people who condition poorly and who, therefore, fail to acquire the conditioned responses characterizing the socialization process (Eysenck, 1965^{a}, pg. 24).

Franks has conducted a series of experiments supporting Eysenck's theory. In one study by Franks (1956) 35 extraverted and 35 introverted subjects as measured by the MPI were compared on eyeblink conditioning. The UCS was an airpuff to the eye, the CS was a pure tone, and a partial reinforcement schedule was used. At all stages the introverted group showed approximately twice as many conditioned responses as the extraverted group. In 1957 Franks replicated this study, again using an airpuff as UCS and tone as CS. He obtained a significant correlation of -.46 between conditioning and extraversion for the number of acquired conditioned responses to extinction. In a third study by Franks and Leigh (1959) 20 inpatient neurotics, 20 asthmatics, 20 outpatient neurotics, and 20 normals were compared on eyeblink conditioning using the same paradigm as the above studies. A significant correlation of -.26 was obtained between extraversion and conditioning.

Several unpublished master's theses have also found significant extravert-introvert differences in eyeblink conditioning. Barendregt (cited in Eysenck, 1965^{b}) following Franks, found a correlation of .29 between eyeblink conditioning and introversion. Brebner (cited in Eysenck, 1965^{b}) used a 60 percent reinforcement schedule and also used an airpuff as UCS and a tone as CS. His criterion was four conditioned responses on successive test trials. He also found that introverts conditioned more than twice as fast as extraverts.

Symon (cited in Eysenck, 1965b) used a paradigm similar to Brebner but limited herself to 18 test trials and 30 reinforcement trials. She used as her score the total number of conditioned responses performed by members of the two groups. She also obtained a significant and positive correlation between introversion and conditioning. She also combined her results with those of Brebner to discover the earliest trial on which a conditioned response occurred. The mean for introverts was the fourth trial and for extraverts the eighth trial. The influence of sex and experimenter was found to be insignificant.

Other investigators have not confirmed this difference in conditioning between introverts and extraverts. A study by Field and Brengelmann (1961), using the conditioning paradigm followed in the Franks study, only succeeded in finding low negative correlations between eyeblink conditioning and extraversion. Eysenck (1965) criticizes this study on the basis that the subjects were prisoners and thus constituted an inappropriate sample.

A study by Becker, Wesley, and Matteson (1961) also disputed Eysenck's theory. They hypothesized that there would be no difference between extraverts and introverts in conditioning but there would be a difference between high and low anxious subjects, since anxiety would serve as a drive, thus building up reactive inhibition and interfering with learning. On a tape with 105 words on it, the word respect occurred 20 times and each time it was followed by a one-second shock. Using GSR amplitude as a criterion their prediction was confirmed; there was no extravert-introvert difference in learning but low anxious subjects showed greater conditioning.

Despite these negative findings there seems to be considerable experimental support for extravert-introvert differences in learning and, thus, Eysenck's theory seems supported in this respect.

Reminiscence.-- Reminiscence is defined as "an increase in function during a period of time in which there is no overt practice on the learned activity" (Woodworth and Schlosberg, 1964, pg. 796). Eysenck has utilized the reminiscence phenomenon to support his hypothesis that extravert-introvert differences are due to differential accumulation of reactive inhibition. He posits that the greater accumulation of reactive inhibition in extraverts has depressed their performance and will dissipate over a rest period; therefore, extraverts will show a greater increase in performance following a rest period as compared to introverts, whose pre-rest performance was not as dampened by accumulation of reactive inhibition. Eysenck quotes a number of studies both by himself and others in support of this theory (Eysenck, 1965^{b}), but, in fact, these studies provide at best only partial and meager support for introvert-extravert differences in reminiscence effect. In one of the first experimental tests by Star (cited in Eysenck, 1961), subjects were measured on their ability to keep a stylus in contact with a circle on a pursuit roter. There were sixteen ninety-second trials of massed practice separated by five-minute rest periods. Although correlations between extraversion and reminiscence were low and not significant, they were non-random and generally positive. A follow-up study by Das (cited in Eysenck, 1961) increased the rest periods to ten minutes, but,again the results were not significant. However, a later study by Star (1963), which also involved performance on a pursuit roter revolving at 60 RPM, tested subjects on four five-minute practice periods separated by three ten-minute rest periods. In this study, Star found significant differences between extraverts and introverts, with extraverts showing a significantly greater decrement in performance and significantly greater reminiscence.

Although a study by Eysenck (1960^a) again yielded non-significant results, he did determine that the most favorable design for obtaining the reminiscence effect was one-minute practice periods separated by five-minute rest periods. Utilizing this design, subjects were given eleven one-minute practice periods separated by ten five-minute rest periods (Eysenck, 1960^b). The criterion was performance on a pursuit roter rotating at 60 RPM and reminiscence was measured by subtracting the pre-rest practice score from the post-rest practice score. Only one of the ten reminiscence measures thus obtained showed a significant correlation with extravertion-introversion, although eight of the remaining nine scores were in the predicted direction.

A dissertation by Stein (1963) required the repeated printing of the letter 'S' for five-minute practice periods separated by ten-minute rest periods. Stein found no difference in rate of decrement in the practice period of reminiscence between extraverts and introverts.

Eysenck suggests that the failure to obtain significant differences in reminiscence between extraverts and introverts may be due to the non-perfect validity of the MPI and/or the unreliability of the reminiscence effect. However, it is also feasible that this failure may be due to the fact that the observed differences in learning between extraverts and introverts are not due to differential accumulation of reactive inhibition. This study will test an alternative explanation: interference theory.

Interference Theory

Interference theory has had a rather varied and diversified history in psychology. In this study it is involved with the factor of attention, which is defined as "the ability to attend to relevant stimuli and to disregard and not be distracted by irrelevant stimuli (Woodworth and Schlosberg, 1964, pg. 72).

In one of the first studies using interference, Hovey (1928) matched two groups of students on the basis of their Army Alpha IQ scores. Six weeks later the control group took a parallel form under normal conditions while the experimental group took it under conditions of auditory (buzzer) and visual (flashing lights) distractions. There was a slight, but non-significant, decrement in scores for the experimental group. In a similar experiment (Smith, 1951) the distractions were loud and sporadic bursts of noise and the tasks were number checking, name checking, and the paper formboard test. Again, there were no significant differences between control and experimental groups.

Fendrick (1937) investigated the effects of music distraction upon reading efficiency. The distraction was semi-classical music. He found a consistent loss in comprehension of the reading matter as measured by true-false tests. A similar study by Henderson (1945) matched students on reading ability as measured by the Nelson Denny Reading Test. In the first experimental group, the distracting stimulus was popular music (Frank Sinatra, etc.), while in the second group classical music was the distracting stimulus. Henderson found that the popular music group showed a significant decrement in comprehension but the classical music group did not, as compared to the control group.

In a study by Bee (1966) male and female subjects performed a mental task (solving math problems and anagrams) with and without auditory distractors (buzzer and music). For both sexes combined, the distraction caused a significant performance decrement but females were more affected than males. Eysenck and Thompson (1966) investigated the effect of distraction on pursuit roter learning. Each subject attempted to keep a stylus in contact with a target on a pursuit roter. The distracting task consisted of pressing either a right or left foot pedal in response to one of two distinctive auditory signals. The distraction resulted in a significant performance decrement.

In an extensive review of the literature, Lang and Buss (1965) hypothesize that an inability to exclude extraneous stimuli might be the cause of the impairment in learning and performance in schizophrenia. For example, Chapman and McGhie (cited in Lang and Buss, 1965) found that when a sporadic, high-pitched noise was introduced, schizophrenics displayed a greater increase in errors on a visual tracking task (pursuit roter) than either normals or non-psychiatric patients. In a second study, Chapman and McGhie (cited in Leng and Buss, 1965) instructed subjects to spin a wheel at a constant rate while listening to varying rates from a taped metronome. Again, schizophrenics showed a greater decrement in performance than the other two groups in that the rate at which they spun the wheel was significantly influenced by the metronome.

Studies by Comalli and Schiller used the Stroop Color-Word Test to investigate the interference phenomenon. Although Comalli's study (1962) was oriented toward developmental differences, the data on his college students are pertinent to the present study. The experimental task was color naming. The control condition (A) required the subjects to read off colors drawn in rectangular patches, while in the experimental condition (B) the subjects were presented with color words written in incongruent colors (red written in green; black written in brown) but the task was still to read the color the word was written in, not the word itself. The criterion was the number of seconds required to read off the colors. Results indicated that the experimental condition was quite interfering in that it took significantly longer to read off the colors when they were in form of words as opposed to the rectangular patches.

Schiller's study (1966) also investigated the developmental aspects of interference but, again, that part of his study dealing with college freshmen is pertinent to the present study. First, his subjects were presented with an $8\frac{1}{2}$ by 11 white card on which was printed in random order 40 color strips of four colors. On the basis of time required to read off the colors, subjects were divided into four groups. Each of the four groups received one of four test cards; for each of these the task was to name colors. Card A presented incongruent color words, i.e., color words written in a different color; Card B presented the words tan, purple, gray, and black written in the four colors; Card C presented the words lemon, fire, sky, and grass written in different colors; Card D presented nonsense syllables written in different colors. Results indicated that Card A took the longest to read, followed in descending order by B, C, and D. In other words, the color words were most interfering and the nonsense syllables least.

Experimenter Expectancy

In an extensive review of the literature, Rosenthal (1966) has shown that experimenter expectancy is a significant determinant of subject response. For example in a study by Stanton and Baker (1942), 20 photographs were selected which were rated on the average as experiencing neither success or failure. These neutral pictures were then presented to ten students in an undergraduate course in experimental psychology, and the experimenters were instructed to replicate "well-established" experimental findings. Five of the experimenters were told that their subjects would average a positive (successful estimate) rating on the photos, while five were told that their subjects would average a negative rating. The results showed that the experimenters did obtain a significantly positive or negative average according to the expectancy.

Fode (cited in Rosenthal, 1966) duplicated the above with one change. The experimenters did not handle the photographs, which served two purposes: the subjects would have the experimenter in his field of vision much less often and the number of cues observed by the students would be reduced, and any cues derived from the experimenter's handling of the pictures would be eliminated. Nevertheless, the results were identical to Stanton's study. In summary, although Rosenthal states that no well-specifiable system of unintentional signaling has been uncovered, the communication of these expectancies seems to be a well-established finding. To control for this in the present study, the subjects will be coded so that the experimenter will not know whether they fall in the extravert or introvert category.

A Statement of the Problem and Hypotheses

The failure to obtain conclusive findings on the reminiscence studies cast doubt on Eysenck's reactive inhibition hypothesis. This study will investigate the possibility that the differences in ability to perform between extraverts and introverts may be better understood in terms of an interference phenomenon. Eysenck describes the typical extravert as one who "craves excitement....is an impulsive individual.... prefers to keep moving," while the typical introvert is "reserved and distant....looks before he leaps....likes a well-ordered way of life" (Eysenck, 1962, pg. 4). Thus, the typical extravert seems to be very distractible and reactive, while the typical introvert seems to be more contained,with greater powers of attention. Therefore, this study will experimentally test the reactive inhibition and interference theories to determine which is more explicable of extravert-introvert differences.

Hypothesis I: There will be no initial differences in performance between extraverts and introverts.

Hypothesis II: There will be no difference in reminiscence between extraverts and introverts.

Hypothesis III: Irrelevant stimuli will have a greater detrimental effect on the performance of extraverts than introverts.

CHAPTER II

METHOD

Subjects

The subjects were 60 female students enrolled in a psychology course at the University of Florida who volunteered for this experiment to fulfill a course requirement.

Selection.-- The MPI (Appendix A) was administered to 150 students and the 30 highest scores (extraverts) and the 30 lowest scores (introverts) were used in the study proper. The extraverts and introverts were each divided into groups, experimental and control, so that each of the four groups contained 15 subjects. The groups were matched on the neuroticism scale, since studies have shown that the two scales lose their orthogonality when scores fall in the extremes. There was no control for intelligence, which has been shown to be unrelated to the two dimensions (Eysenck, 1962).

To control for experimenter expectancy, the experimenter did not know his personality group when subjects participated in the experiment.

Materials

The materials consisted of the MPI, the Stroop Color-Word Test, a tape recorder, and a stopwatch. The materials for the Stroop Color-Word Test consisted of three $8\frac{1}{2}$ by 11 sheets of paper. The first paper (A) consisted of eight rectangular patches ($\frac{1}{4}$ by 3/4) of color (black, brown, blue, purple, orange, red, green, yellow). The second paper (B) consisted of these colors randomized in five rows of 30 each for a total of 150 rectangular patches. The third paper (C) consisted of 128 color words randomized in four rows of 32 each but these words were drawn in an incongruent color. For example, the word red might be written in green, the word black might be written in brown, etc. The size of the words and both the color words and the color they were drawn in were the same as in (B). The tape recorder was used to record the responses of the subjects for later transcription.

Experimental Procedure

The experimental task was to read off colors as quickly as possible. The experimenter and subject sat side by side in front of a 30-inch-high table on which the test materials were placed. First, the following instructions were read:

> Your task is to read off rectangular patches of color as quickly as you can. The colors are arranged in rows and you will start at the top of the first row, read to the bottom and then go to the next row and so on. (Hand Card A to S) Please read these colors off. This is what the test sheet will look like, except there will be many more colors for you to read. (Remove Card A and place Card B on table) This paper must lay flat on the table. You cannot hold it in your hands but you can arrange it at an angle which will facilitate your reading. Do that now.
>
> I will be taping this but you will begin when I say "GO" and not when I turn the recorder on. I will remove the cover. Remember to read the colors as quickly as you can. Do you have any questions?

After reading the instructions, Card A was presented to the S to read off the colors. This card both familiarized S with the task and enabled E to correct any erroneous color identifications. Card B, covered to prevent premature identification of the colors, was then placed in front of S and the tape recorder was turned on about ten seconds before the practice period began. At the signal "GO" the cover was removed and S read off the colors as quickly as possible for one minute until the signal "STOP," at which time the card was covered and the following instructions were read.

> Now you will have a five-minute break and during this time you must remain seated and you cannot read or write. Conversation between us must be kept to a minimum. Is this clear? After the five-minute break you will have another practice period, starting at the top of the first row and reading the colors as quickly as you can.

After a five-minute rest period, there was another one-minute practice period. A stop watch was used to keep time.

The subjects in the control group followed this procedure for nine one-minute practice periods separated by eight five-minute rest periods. The purpose of the control group was to evaluate the practice effect. The subjects in the experimental groups also followed the same procedure but they received different test materials for the last five practice periods. After four minutes of the five-minute practice period following the fifth practice period,Card C, covered, was presented to the experimental subjects and the new task was explained.

> In the second part of the experiment your task is still to read off colors as quickly as you can, but now the colors are no longer in rectangular patches. Instead, the colors are in the form of words and the words themselves are color words, but the color and the color word are incongruent. For example, the word red might be drawn in blue, the word black might be drawn in brown. If the word yellow were drawn in green, you would say ___________ (If S says green, E continues on; if not, S is corrected and another example is given until S understands task). The colors are still in rows and you are to read from top to bottom, just as before. Remember, name the color, not the word.

Card C presented color words written in incongruent colors, and, since the task was still to read off colors, the color words served as an interfering stimulus. Thus, following the five-minute rest period after the fifth practice period, the Ss in the experimental groups received the interfering stimulus for four one-minute practice periods separated by three five-minute rest periods. Therefore, both experimental and control groups received nine one-minute practice periods separated by eight five-minute rest periods.

At the conclusion of the experiment the purpose of the study was explained to the S and S was requested not to discuss the experiment with anyone until it was completed in one week.

CHAPTER III

RESULTS

Preliminary Analyses: Categorization of Subjects by MPI Scores

Extraversion-Introversion.-- Before proceeding to the main analyses, a Two-Way Fixed Effects Analysis of Variance (Hays, 1966) was used to determine both that the MPI scores significantly differentiated the extravert and introvert groups and that the MPI extraversion-introversion scores of the experimental and control groups were not significantly different. The mean MPI scores of the four subject groups are presented in Table 1.* The analysis of variance is summarized in Table 2.

Table 1

MPI SCORES--EXTRAVERSION

Group	Mean
Introvert Control	13.0
Introvert Experimental	13.8
Extravert Control	24.1
Extravert Experimental	23.9

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* Note: MPI scores are listed in Appendix B.

Table 2

ANALYSIS OF VARIANCE FOR MPI SCORES

Source	SS	df	MS	F	P
Personality (P)	1643.27	1	1643.27	40.30*	$<.01$
Condition (C)	.27	1	.27	.01	n.s.
PxC	6.67	1	6.67	.16	n.s.
Error	2283.73	56	40.78		
Total	3933.94	59			

As Table 2 indicates, the MPI scores of introverts and extraverts were significantly different (F 40.30); while the MPI scores of the experimental and control groups were not significantly different ($P>.05$). There was no significant interaction between extraversion-introversion score on the MPI and belonging to an experimental or control condition ($P>.05$).

Neuroticism.-- A One-Way Analysis of Variance (Hays, 1966) was used to ascertain that the MPI neuroticism scores of the four groups were not significantly different. The neuroticism scores are summarized in Table 3. The analysis of variance is summarized in Table 4.

Table 3

MPI SCORES--NEUROTICISM

Group	Mean
Introvert Control	25.8
Introvert Experimental	25.6
Extravert Control	23.6
Extravert Experimental	24.1

Table 4

ANALYSIS OF VARIANCE FOR MPI SCORES

Source	SS	df	MS	F	P
Between _Ss_	52.85	3	17.62	.22	n.s.
Within _Ss_	4437.38	56	79.24		
Total	4490.18	59			

As Table 4 indicates, the four groups did not differ significantly on their neuroticism scores ($P \geq .05$).

To summarize these two analyses, the introvert and extravert groups were significantly different, the experimental and control groups were not significantly different, and the four groups were not significantly different on their neuroticism scores.

Main Analyses: Initial Performance

For analysis of the main effects, the first five one-minute practice periods were divided into six ten-second trials (A-F). In all analyses the performance measure was the number of correctly named colors.

Hypothesis I stated that the initial performance of the four groups would not be significantly different. The criterion was the number of colors correctly named during the first ten-second trial (A) of the first one-minute practice period. The mean performance for the four groups are presented in Table 5. A One-Way Analysis of Variance was used to analyze the results (Hays, 1966) and is summarized in Table 6.

Table 5

INITIAL PERFORMANCE

Group	Mean
Introvert Control	21.0
Introvert Experimental	21.4
Extravert Control	22.3
Extravert Experimental	21.1

Table 6

ANALYSIS OF VARIANCE--INITIAL PERFORMANCE

Group	SS	df	MS	F	P
Between	23611.98	3	7870.66	1.74	n.s.
Within	253507.87	56	4526.93		
Total	277119.85	59			

As Table 6 indicates, the performance of the four groups during the first ten seconds was not significantly different ($P > .05$), indicating that the four groups were equally facile at the task at the outset. Therefore, Hypothesis I was supported.

Main Analyses: Reminiscence Effect

Hypothesis II stated that there would be no difference between extraverts and introverts in reminiscence effect. Since the analysis involved only the first five practice periods, the experimental and control groups were combined. To measure the reminiscence effect, performance on the last ten seconds (trial F) of the first practice period was subtracted from the performance on the first ten seconds (trial A) of the second practice period, trial F of the second practice period from trial A of the third, and so on for each subject for the first five practice periods. A t-test (Hays, 1966) was used to compare the means of the four reminiscence measures thus obtained, and the results of this analysis are summarized in Table 7.

Table 7

t-TEST--REMINISCENCE EFFECT

Group	Mean	t	P
Introverts	6.11	.318	n.s.
Extraverts	5.86		

As Table 7 indicates, there was no difference in reminiscence between extraverts and introverts ($P > .05$). Therefore, Hypothesis II was supported.

Main Analyses: Interference Effect

Hypothesis III stated that irrelevant stimuli would have a greater detrimental effect on the performance of extraverts than of introverts.

Comparison of means.-- In this analysis, the criterion measure was the difference between the mean performance on the last four practice periods as compared to the mean performance on the first five practice periods. A Two-Way Fixed Effects Analysis of Variance was used to analyze the results (Hays, 1966) and this analysis is summarized in Table 8.

Table 8

INTERFERENCE EFFECT--COMPARISON OF MEANS

Source	SS	df	MS	F	P
Personality (P)	18.4040	1	18.4040	.216	n.s.
Condition (C)	36176.8815	1	36176.8815	425.620*	.01
PxC	102.4093	1	102.4093	1.20	n.s.
Error	4759.8867	56	84.9980		
Total	41057.5815	59			

As Table 8 indicates, the performance of extraverts and introverts was not significantly different ($P > .05$). There was a very significant difference in performance between the experimental and control groups ($P < .01$) indicating that the interference stimulus resulted in a significant performance decrement, regardless of personality group. Performance differences due to the interaction of personality group and experimental condition were not significant ($P > .05$), although they were in the predicted direction. In other words, extraverts did not suffer a significantly greater decrement in performance during the interference condition relative to introverts. Therefore, Hypothesis III was not supported by this analysis. A graphic representation of these data is presented in Figure 1.

Comparison of repeated measures.-- The criterion measure for this analysis was the difference between the mean performance on the first five practice periods and performance on each of the last four practice periods (six through nine). The purpose of this evaluation was to determine if there were any performance differences between the last four practice periods as a function of the interference stimulus. A Three-Factor Analysis with Repeated Measures on the Third Factor was used (2 x 2 x 4) (Winer, 1962).

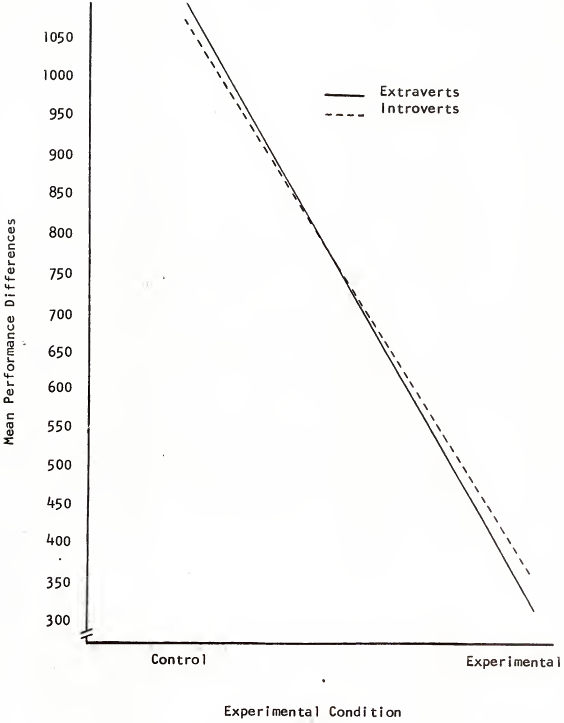

Figure 1. Interference Effect--
Comparison of Means

The first part of this analysis, which does not involve the repeated measures, is summarized in Table 9.

Table 9

INTERFERENCE EFFECT--COMPARISON OF FIRST FIVE AND LAST FOUR PRACTICE PERIODS

Source	SS	df	MS	F	P
Personality (P)	80.19	1	80.19	.27	n.s.
Condition (C)	144511.15	1	144511.15	487.54*	.01
PxC	394.33	1	394.33	1.33	n.s.
Error	16598.79	56	296.41		
Total (between)	161584.46	59			

As Table 9 indicates, the performance of extraverts and introverts was not significantly different ($P > .05$). There was a very significant difference in performance between the experimental and control groups ($P < .01$). There was no significant interaction between personality group and experimental condition ($P > .05$), although the results were in the predicted direction. As expected, these results were quite similar to the analysis for the comparison of means and, as before, do not support Hypothesis III. A graphic representation of this data is presented in Figure 2.

The results of this analysis involving interaction with the repeated measures are summarized in Table 10.

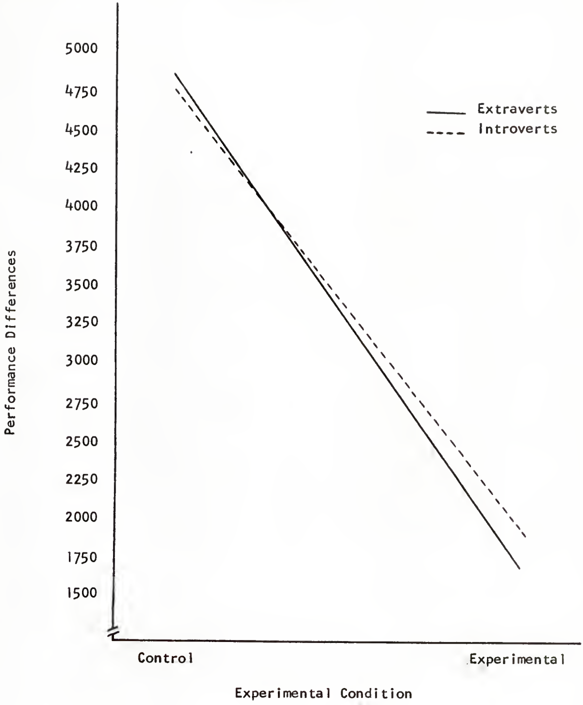

Figure 2. Interference Effect--
Comparison of First Five and
Last Four Practice Sessions

Table 10

INTERFERENCE EFFECT--COMPARISON OF REPEATED MEASURES

Source	SS	df	MS	F	P
Repeated Measures (RM)	2733.28	3	911.10	25.17*	.01
PxRM	14.56	3	4.85	.13	n.s.
CxRM	1636.16	3	545.39	17.83*	.01
PxCxRM	14.73	3	4.91	.14	n.s.
Error (within)	6081.69	168	36.20		

As Table 10 indicates, there was a significant repeated measures effect (P .01). This results from the linear improvement in performance from the sixth to the ninth practice periods. The interaction of personality and performance on the repeated measures was not significant (P .05); extraverts and introverts did not differ in their relative performance from the sixth through the ninth practice periods. The interaction of experimental condition and performance on the repeated measures was significant (P .01); subjects in the experimental condition showed a linear and significant improvement in performance over the four interference practice periods,while this was not true for subjects in the control condition. The three-way interaction of personality, experimental condition, and repeated measures was not significant (P .05). Introverts and extraverts in the experimental and control conditions did not differ significantly in their relative performance from the sixth through the ninth practice periods. Thus, Hypothesis III was not supported by this analysis. Graphic representations of these results are presented in Figures 3, 4, 5, and 6. Table 11 presents the combined results summarized in Tables 9 and 10.

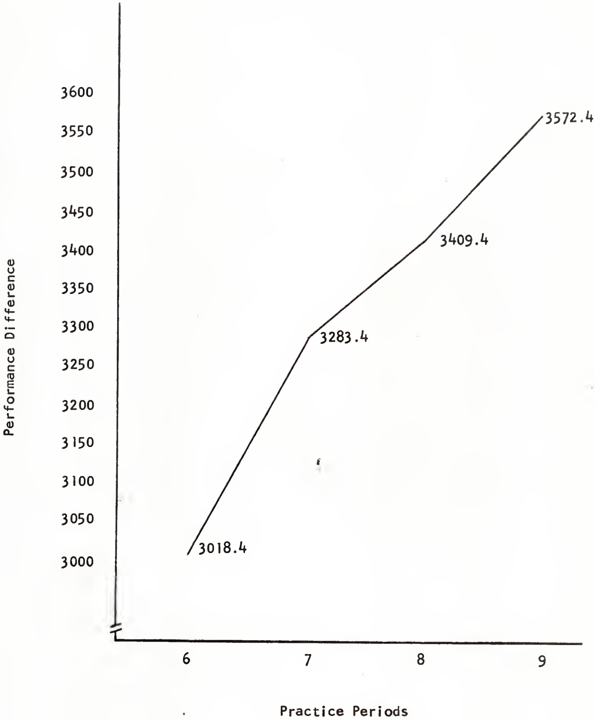

Figure 3. Performance on Repeated Measures

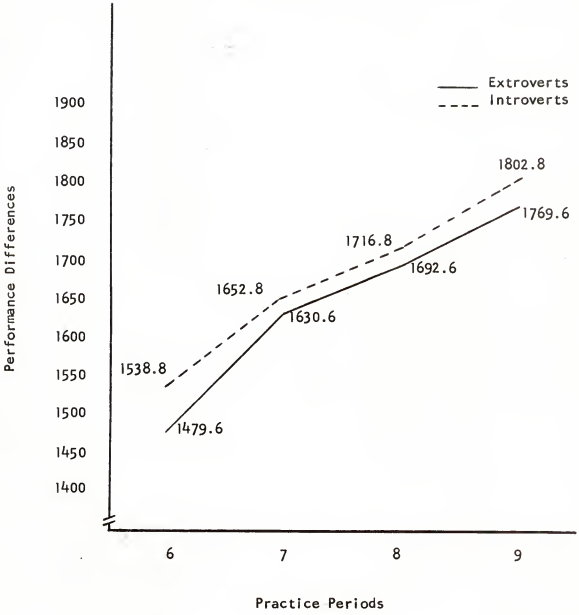

Figure 4. Personality and Performance Over the Repeated Measures

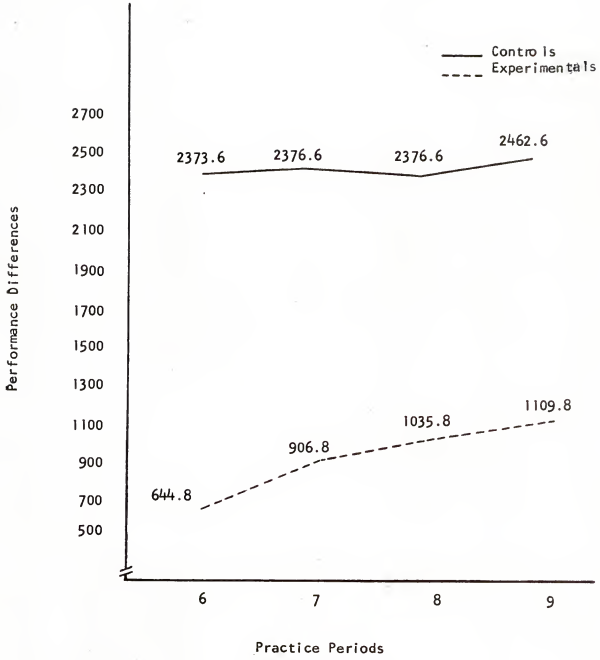

Figure 5. Experimental Condition and Performance Over the Repeated Measures.

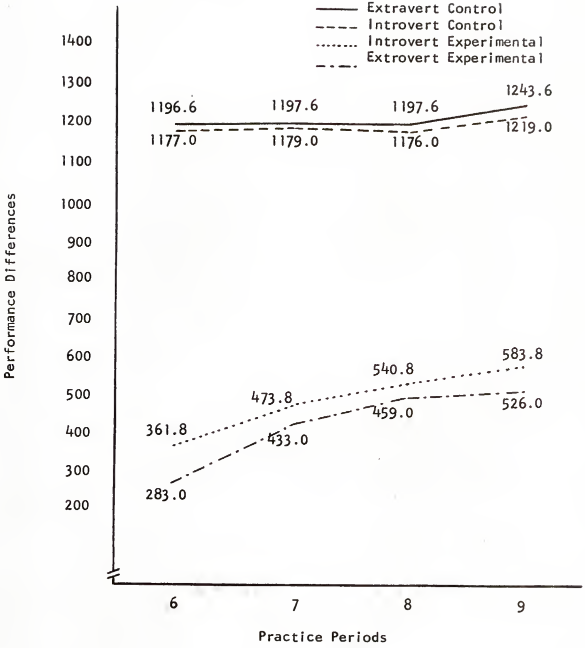

Figure 6. Interaction of Personality and Experimental Condition on Performance Over the Repeated Measures.

Table 11

INTERFERENCE EFFECT--THREE-WAY ANALYSIS WITH REPEATED MEASURES ON THE THIRD FACTOR

Source	SS	df	MS	F	P
Between Subjects	161584.46				
Personality (P)	80.19	1	80.19	.27	n.s.
Condition (C)	144511.15	1	144511.15	487.54*	.01
PxC	394.33	1	394.33	1.33	n.s.
Error (between)	16596.79	56	296.41		
Within Subjects	10480.42				
Repeated Measures (RM)	2733.28	3	911.10	25.17*	.01
PxRM	14.56	3	4.85	.13	n.s.
CxRM	1636.16	3	545.39	17.83*	.01
PxCxRM	14.73	3	4.91	.14	n.s.
Error (within)	6081.69	168	36.20		
Total	172064.88	239			

Summary of Results

Initial performance.-- A One-Way Analysis of Variance on the performance in the first ten seconds of the first one-minute practice period of the four subject groups yielded a non-significant F ratio. Therefore, the four groups were equally facile at the task at the outset, and Hypothesis I was supported.

Reminiscence.-- A t-test on the means of the four reminiscence measures yielded a non-significant result, indicating that reactive inhibition did not accumulate to a greater degree in extraverts than introverts. Therefore, Hypothesis II was supported.

Interference.-- A Two-Way Fixed Effects Analysis of Variance indicated that the performance of extraverts and introverts on the last four trials relative to their performance on the first five trials was not significantly different, and the interference stimulus did not result in a greater performance decrement in extraverts as compared to introverts. There was a very significant performance difference between the experimental and control groups, indicating the effectiveness of the interference stimulus.

The first part of a Three-Factor Analysis with Repeated Measures on the Third Factor was congruent with the above results. In addition, positive F ratios were obtained for the repeated measures factor and the interaction of experimental condition and repeated measures. In other words, there was a linear improvement in performance across the last four practice periods and this was due predominantly to the improvement in the experimental condition. Extraverts' and introverts' performance across the repeated measures was not significantly different, and extraverts and introverts in the experimental and control conditions did not differ significantly in their relative performance from the sixth through the ninth practice periods. Therefore, neither this analysis nor the previous one supported Hypothesis III.

CHAPTER IV

DISCUSSION AND CONCLUSIONS

Discussion

In this chapter the implications of the results will be discussed first, followed by an evaluation of the conditions which produced these results.

Initial performance.-- Hypothesis I stated that there would be no initial difference in performance between extraverts and introverts. This hypothesis was supported and thus permitted the assumption that any subsequent differences in performance between extraverts and introverts can be attributed to conditions occurring within the experimental situation.

Reminiscence.-- Hypothesis II stated that there would be no difference in reminiscence between extraverts and introverts. According to Eysenck's theory, the degree of reminiscence reflects the degree of accumulation and dissipation of reactive inhibition. Since his theory assumes that extraverts build up more reactive inhibition than introverts, they should show a greater reminiscence effect. The finding of no difference in reminiscence between extraverts and introverts supported Hypothesis II and did not support Eysenck's theory. The task used in this experiment produced a clear reminiscence effect and the lack of a significant difference between extraverts and introverts casts considerable doubt on Eysenck's theory of extraversion and introversion.

Interference.-- Hypothesis III stated that extraverts would find an interference stimulus more disruptive than introverts. This alternative to Eysenck's theory suggested that introverts were better able to attend to relevant stimuli and ignore irrelevant stimuli, while extraverts were more distractible and less able to ignore irrelevant stimuli. Hypothesis III was not supported and leads to the conclusion that extraverts and introverts do not differ on the dimension of disruption of performance under interference conditions. However, this conclusion is tempered by the fact that the results were in the predicted direction; introverts did perform better than extraverts under the interference condition, although the difference was not statistically significant.

One possible explanation for the lack of significance under the interference condition may lie in the marked disruptive effect of the interference stimulus. The difference in performance between the experimental and control conditions yielded a remarkably high F ratio of over 400. The overpowering effect of the interference stimulus may have masked any subtle differences in resistance to interference that existed between extraverts and introverts. To give a concrete example, if extraverts could lift a ten-pound weight and introverts a fifteen-pound weight, they would show no difference in performance when given a twenty-pound weight, since neither would be able to lift it. This would lead to the erroneous conclusion that they were equal in strength. The fact that introverts did perform better than extraverts under the interference condition gives further credence to the hypothesis that a milder interference stimulus might have permitted any significant difference between extraverts and introverts to become manifest.

Results also indicated a significant improvement in performance from the sixth to the ninth practice periods and this improvement occurred primarily in the experimental condition. Evidently, the performance of subjects in the control condition approached an asymptote by the fifth practice period and there was little subsequent improvement in performance in the last four practice periods. Subjects in the experimental condition showed a sharp drop in performance on the sixth practice period, when they first received the interference stimulus. It was an unfamiliar task and they had considerable difficulty coping with it. The subjects then showed a significant, linear improvement in performance on the seventh, eighth, and ninth practice periods, suggesting there was a progressive increase in learning to cope with the interference stimulus. However, there was no significant difference in improvement of performance between extraverts and introverts. This is a significant finding, for Eysenck's theory would have predicted a greater improvement in learning for introverts. Since a difference in learning ability is the basis for differentiating between introverts and extraverts, this finding casts some doubt on the validity of discriminating individuals on a continuum of extraversion-introversion.

In comparing this study to others which have supported Eysenck's theories, one significant difference may be the removal of experimenter expectancy in the present study. At the time of the experiment, the experimenter did not know whether the subject was an introvert or an extravert. Most of the original studies supporting Eysenck's theories were unpublished master's theses conceived under the supervision of Eysenck. One would expect a strong experimenter expectancy effect in these cases. However, the influence of experimenter can only be evaluated by a replication of this study with the experimenter aware of the personality group of the subject at the time of the experiment.

An evaluation of the conditions which produced the above results will be discussed under the heads of Maudsley Personality Inventory and the Experimental Procedure.

Maudsley Personality Inventory

Extraversion-Introversion

Although the MPI scores of the extravert and introvert groups were significantly different, there were several indications that these two samples were more homogeneous than the population of extraverts and introverts which they represented. They were both enrolled in college and, therefore, oriented toward academic learning. In addition, results of this study indicated that extraverts and introverts showed no difference in learning ability across the last four practice periods. Thus, introverts and extraverts shared an orientation toward and a capacity for learning, while Eysenck theorized that the capacity for learning marked the fundamental difference between these two groups. Thus, learning differences assumed to exist between the population of extraverts and introverts did not exist between these two samples. Therefore, these two groups, and especially the extravert group, may not have been representative of the total population of extraverts and introverts. The use of subjects not enrolled in college might result in samples of extraverts and introverts which were more differentiated on the dimension of learning ability.

Neuroticism

The four subject groups were matched on the neuroticism scale to remove this factor as a possible source of variance. Equating the subjects on this dimension makes the implicit assumption that a certain score on the neuroticism scale represents the same subjective experience, the same salience, for extraverts and introverts. For example, if it is assumed for purposes of illustration that neuroticism can be interpreted as anxiety, then according to this assumption a score of 40 represents an equal amount of subjectively experienced anxiety for extraverts and introverts. However, this assumption may be erroneous. By definition,introverts experience more anxiety than extraverts. Therefore, the questions on the neuroticism scale may have greater salience for introverts than extraverts. The two groups may not have been experientially matched on the neuroticism scale, then, and if the introverts were more anxious than the extraverts, their performance on the experimental task would have been confounded by this uncontrolled source of variance.

Experimental Procedure

Experimenter-Subject Relationship

During this experiment, the experimenter and subject sat side by side and, although no conversation was permitted, the presence of the experimenter may have had a differential effect on the performance of extraverts and introverts. According to Eysenck, extraverts are more outgoing and more oriented toward interpersonal relationships. Therefore one may hypothesize that extraverts may have had more of a "need" than introverts to establish a more active relationship with the experimenter and the prohibiting of this may have been frustrating for the extraverts.

The experience of frustration and any other negative feelings resulting from the imposed silence may have had a more detrimental effect on the performance of extraverts.

Stimulus Materials

On a more theoretical level, the use of color as the stimulus material may have had a differential effect on extraverts and introverts. On the Rorschach Inkblot Test extraverts are theoretically more stimulated by and produce more responses to color than introverts (Klopfer and Davidson, 1962). If color in this experiment produced a similar reaction in extraverts, this may have facilitated and improved their performance relative to introverts, who are not as stimulated by color. Thus, the differential effect of color on extraverts and introverts may have been an uncontrolled source of variance.

Conclusions

The results of this study did not offer support for Eysenck's theory of reactive inhibition. In addition, introverts did not demonstrate greater learning than extraverts. It was hypothesized that experimenter expectancy may have been related to positive results obtained in previous studies. The alternative interference theory was also not supported, although the results were in the predicted direction. A number of possibilities were offered to explain the lack of significance on the test of interference. The first possibility was, of course, that extraverts and introverts may not differ on this dimension. Other possibilities discussed were the overpowering effect of the interference stimulus, the representativeness of the extravert and introvert samples, the subjective experience of neuroticism, the experimenter-subject relationship, and the effect of color as the stimulus material.

With respect to modifications of this experiment to retest the effect of interference on extraverts and introverts, two of the above-mentioned possibilities seem most important: the interference stimulus and the subject pool. A milder interference stimulus which did not involve color might allow any significant differences to become manifest. Using non-student subjects might result in more distinctive samples of extraverts and introverts, in particular, a greater differentiation in learning skills.

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APPENDICES

APPENDIX A

MAUDSLEY PERSONALITY INVENTORY

Instructions

Here are some questions regarding the way you behave, feel, and act. After each question is a space for answering "Yes," "?" or "No."

Try and decide whether "Yes," or "No" represents your usual way of acting or feeling. Then blacken in the space under the column headed "Yes" or "No." If you find it absolutely impossible to decide, blacken in the space headed "?" but use this answer only occasionally.

Work quickly, and don't spend too much time over any question; we want your first reaction, not a long drawn-out thought process. The whole questionnaire shouldn't take more than a few minutes. Be sure not to omit any questions. Now turn the page over and go ahead. Work quickly, and remember to answer every question. There are no right or wrong answers, and this isn't a test of intelligence or ability, but simply a measure of the way you behave.

Questions

1. Are you happiest when you get involved in some project that calls for rapid action?
2. Do you sometimes feel happy, sometimes depressed, without any apparent reason?
3. Does your mind often wander while you are trying to concentrate?
4. Do you usually take the initiative in making new friends?
5. Are you inclined to be quick and sure in your actions?
6. Are you frequently "lost in thought" even when supposed to be taking part in a conversation?
7. Are you sometimes bubbling over with energy and sometimes very sluggish?
8. Would you rate yourself as a lively individual?
9. Would you be very unhappy if you were prevented from making numerous social contacts?

APPENDIX A--continued

10. Are you inclined to be moody?

11. Do you have frequent ups and downs in mood, either with or without apparent cause?

12. Do you prefer action to planning for action?

13. Are your daydreams frequently about things that can never come true?

14. Are you inclined to keep in the background on social occasions?

15. Are you inclined to ponder over your past?

16. Is it difficult to "lose yourself" even at a lively party?

17. Do you ever feel "just miserable" for no good reason at all?

18. Are you inclined to be overconscientious?

19. Do you often find that you have made up your mind too late?

20. Do you like to mix socially with people?

21. Have you often lost sleep over your worries?

22. Are you inclined to limit your acquaintances to a select few?

23. Are you often troubled about feelings of guilt?

24. Do you ever take your work as if it were a matter of life or death?

25. Are your feelings rather easily hurt?

26. Do you like to have many social engagements?

27. Would you rate yourself as a tense or "highly-strung" individual?

28. Do you generally prefer to take the lead in group activities?

29. Do you often experience periods of loneliness?

30. Are you inclined to be shy in the presence of the opposite sex?

31. Do you like to indulge in a reverie (daydreaming)?

32. Do you nearly always have a "ready answer" for remarks directed at you?

33. Do you spend much time in thinking over good times you have had in the past?

APPENDIX A--continued

34. Would you rate yourself as a happy-go-lucky individual?

35. Have you often felt listless and tired for no good reason?

36. Are you inclined to keep quiet when out in a social group?

37. After a critical moment is over, do you usually think of something you should have done but failed to do?

38. Can you usually let yourself go and have a hilariously good time at a gay party?

39. Do ideas run through your head so that you cannot sleep?

40. Do you like work that requires considerable attention?

41. Have you ever been bothered by having a useless thought come into your mind repeatedly?

42. Are you inclined to take your work casually, that is as a matter of course?

43. Are you touchy on various subjects?

44. Do other people regard you as a lively individual?

45. Do you often feel disgruntled?

46. Would you rate yourself as a talkative individual?

47. Do you have periods of such great restlessness that you cannot sit long in a chair?

48. Do you like to play pranks upon others?

APPENDIX B

MAUDSLEY PERSONALITY INVENTORY SCORES

Introvert Control		Introvert Experimental	
Extraversion	Neuroticism	Extraversion	Neuroticism
17	10	6	30
8	20	16	30
11	29	13	14
16	32	12	35
15	28	10	34
17	24	14	26
6	44	19	33
18	30	17	20
17	21	8	34
12	26	11	28
14	21	18	22
18	28	14	26
19	30	4	17
6	36	18	21
13	8	15	14

Extravert Control		Extravert Experimental	
Extraversion	Neuroticism	Extraversion	Neuroticism
41	30	40	14
39	14	39	20
38	21	42	24
40	21	43	27
37	12	39	29
38	22	40	20
40	16	35	42
36	21	38	23
41	30	38	17
38	16	39	19
30	38	41	11
35	27	34	42
35	32	37	31
42	30	37	25
42	24	39	18

BIOGRAPHICAL SKETCH

Michael Warren Glazer was born June 5, 1942, in Philadelphia, Pennsylvania. In January, 1960, he graduated from Olney High School, Philadelphia, Pennsylvania. In June, 1963, he received the degree of Bachelor of Science with a major in Psychology from the Pennsylvania State University. In August, 1964, he received the degree of Master of Arts in Psychology from Temple University. From September, 1964, until the present time he has pursued his work toward the degree of Doctor of Philosophy.

Mr. Glazer is married to the former Vicki Ianucelli and is the father of a six year old son, Adam.

This dissertation was prepared under the direction of the chairman of the candidate's supervisory committee and has been approved by all members of that committee. It was submitted to the Dean of the College of Arts and Sciences and to the Graduate Council, and was approved as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

June, 1968

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